

Association between temporomandibular disorders and tinnitus in the elderly

Associação entre disfunção temporomandibular e zumbido em idosos

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ABSTRACT

Purpose: To verify the association between tinnitus and temporomandibular dysfunction in the elderly. **Methods:** A cross sectional study was conducted with the inclusion of elderly individuals with independent living. Temporomandibular dysfunction was assessed by odontological evaluation and tinnitus was verified by medical history. Statistical analysis was performed using the chi-square test, relative risk and logistic regression. **Results:** Tinnitus was observed in 82.9% of individuals with temporomandibular dysfunction and through this analysis is shown that temporomandibular dysfunction as a risk factor for tinnitus. **Conclusion:** The results showed that there was association between tinnitus and temporomandibular dysfunction in the elderly population and emphasizes the importance of identifying risk factors for tinnitus that can be modified through specific interventions, since it is essential in the prevention of future episodes, as well as managing the process of treatment of elderly patients in general.

Keywords: Tinnitus; Temporomandibular joint disorders; Elderly; Audiology; Odontology

RESUMO

Objetivo: Verificar a associação entre zumbido e disfunção temporomandibular em idosos. **Métodos:** Estudo transversal realizado com a inclusão de idosos com vida independente. A disfunção temporomandibular foi avaliada por exame odontológico e o zumbido foi verificado pela história médica. A análise estatística foi realizada utilizando o teste Qui-quadrado, o risco relativo e a regressão logística. **Resultados:** O zumbido foi observado em 82,9% dos indivíduos com disfunção temporomandibular e, através desta análise, observou-se que a disfunção temporomandibular é um fator de risco para o zumbido. **Conclusão:** Houve associação entre zumbido e disfunção temporomandibular na população idosa. Ressalta-se a importância de identificar fatores de risco para o zumbido, que podem ser modificados por meio de intervenções específicas, uma vez que esta prática é essencial na prevenção de episódios futuros, bem como na gestão do processo de tratamento de pacientes idosos, em geral.

Palavras-chave: Zumbido; Transtornos da articulação temporomandibular; Idoso; Audiologia; Odontologia

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INTRODUCTION

Increased population aging in Brazil (10.8% of the total population)⁽¹⁾, and in particular in the municipality of Londrina (approximately 66,000 inhabitants aged >60 years), Parana state⁽¹⁾, has aroused the interest of several sectors of society, including that of health professionals, who aim to provide greater comfort and adaptations to the changes that occur with the aging process.

Speech-language Pathology (SLP) is one of the areas that contributes to the prevention and treatment of aging disorders seeking to improve the quality of life of this population⁽²⁾.

Subjective tinnitus, which is a sound heard only by the patient, is presented with many distinct forms and is similar to chronic neuropathic pain. It is commonly observed in the elderly and is a symptom present in a group of diverse pathologies, thus needing different treatments. The clinical approach of tinnitus as a single disease has hindered progress in understanding its pathophysiology, and it is perhaps the most serious obstacle to the development of effective treatments⁽³⁾.

Tinnitus and other hearing symptoms found in the elderly population are commonly reported by patients with temporomandibular disorders (TMD). Although there are several theories regarding the pathophysiology of tinnitus, its precise mechanism has not been elucidated yet, and may be associated with otological, neurological and traumatic causes, adverse drug effects, nutritional deficiencies, metabolic and eating disorders, depression, and TMD⁽⁴⁾.

A study conducted with a sample of the elderly observed prevalence of tinnitus of 42.77%, with difference between tinnitus and hearing loss and correlation between the side affected by tinnitus and that affected by hearing loss⁽⁵⁾.

TMD involve structural and functional changes in the stomatognathic system and are characterized by pain in the temporomandibular joint (TMJ) and masticatory muscles, limitations to mandibular movements, TMJ noise, functional impairments, and otological symptoms⁽⁶⁾.

Some authors⁽⁷⁾ have added that signs and symptoms of TMD may manifest on areas of the face and neck, on temporal, occipital and frontal areas of the head, as well as on pre-auricular and auricular areas. It is estimated that 40-75% of the adult population presents some sign of TMD, and that at least 5% has symptoms⁽⁸⁾.

In the case of tinnitus, it is known that such a symptom results from the dynamic interaction between several centers of the nervous and limbic systems, and that changes and/or lesions in the cochlea are the precursors of this process⁽⁹⁾.

The same authors also stated that tinnitus is the perception of a sound, without there being production by an external source. Tinnitus affects approximately 15% of the world's population⁽¹⁰⁾ and this prevalence can reach 33% among individuals aged >60 years. Increasing age is directly proportional to the presence of multiple auditory symptoms, including tinnitus⁽¹¹⁾.

Prevalence of tinnitus in the population with TMD is higher than that observed in the general population⁽⁷⁾. Some authors stated that the frequency of tinnitus among patients with TMD has been reported with a range of 33 to 76%⁽¹⁰⁾.

The specific scientific literature has documented a controversial debate on the possible association of auditory symptoms with craniomandibular dysfunction (CMD) since 1920⁽¹⁰⁾. This variation results mainly from the methods, instruments and

definitions of TMD used. However, there is need to elucidate this correlation, because understanding the nature and causes of tinnitus is necessary in order to improve prevention and develop appropriate intervention and rehabilitation in view of their high prevalence in the elderly population⁽⁵⁾.

Considering the lack of studies and the relevance of research on this theme to health science, this survey aimed to verify the correlation between tinnitus and TMD in the elderly.

METHODS

This cross-sectional study is part of a project entitled Study on Aging and Longevity (EELO). The study population consisted of elderly individuals of both genders, aged >60 years, with independent living and levels 3 and 4 in the Functional Status Score⁽¹²⁾, who agreed to voluntarily participate in the survey by signing an Informed Consent Form (ICF).

The study sample was calculated based on a population of 43,610 elderly enrolled in the 38 Basic Health Units of the urban area of the municipality of Londrina, Paraná state, Brazil. The sample was randomly stratified considering the five regions of the city as follows: 15% - central region, 27% - northern region, 23% - southern region, 19% - eastern region, and 16% - western region. In addition, the EELO project included 519 individuals of both genders, aged >60 years, with independent living and levels 3 and 4 in the Functional Status Score⁽¹²⁾.

Of this population, a sample of 199 elderly was included in this part of the study to verify the correlation between TMD and tinnitus. The inclusion criteria were as follows: present natural teeth or prostheses (total prosthesis; partial or removable fixed prosthesis) and acceptable functional occlusion. In addition, volunteers should have been rehabilitated for at least one year prior to study commencement, considering that permanence without prosthesis may influence the diagnostic process for TMD.

This study was approved by the Human Research Ethics Committee of the aforementioned Institution (CEP-UNOPAR) according to the Brazilian National Health Council (NHC) resolution no. 196/96 of October 10, 1996.

Information on tinnitus, gender, age, and cephalalgia was collected, based on protocol, by means of audiological anamnesis at the Audiology Clinic of the Speech-language Pathology Department of a higher education institution in the north of Parana state⁽¹³⁾. Complaint of tinnitus including type and side affected was verified.

Functional occlusion was assessed by requesting the patient to perform lateral mandibular movements using cellophane paper to detect occlusal interferences on the non-working side. Discrepancies between the centric relation and the usual intercuspal position were also registered through bilateral manipulation. Individuals who presented marked discrepancies (deviation >4 mm) or uncertain results were excluded from the study. Presence of anterior and lateral guides was verified to classify the patient as with stable functional occlusion. Individuals who were edentulous and not rehabilitated by prostheses were excluded. Moreover, there was concern about the educational level of the individuals in the sample; to participate in the study, after a general explanation of the researchers, the elderly should be able to read, interpret, and respond independently to a questionnaire.

Assessments of this research were conducted by a single examiner previously trained in a calibration process. The calibration

process was conducted by a standard examiner and the training activities were theoretical-practical. At the end of training, calibration of the examiner was verified by the Kappa test⁽¹⁴⁾, in which the results of two evaluations were considered in the same group of 20 elderly.

The elderly selected for this study were interviewed using a questionnaire that aimed to collect information on their general health status, signs and symptoms of TMD, and occlusal aspects.

The questionnaire⁽¹⁵⁾ was applied to the patients without interference of the examiner, so that no expectation was created, which could possibly divert the results of the clinical examination to be performed. The patients responded to ten questions regarding symptoms of TMD, which enable classification of each individual with respect to the presence and severity of these disorders.

Anamnestic questionnaire:

1. Do you have difficulty in opening your mouth?
2. Do you have difficulty in moving your jaw sideways?
3. Do you feel discomfort or muscular pain when chewing?
4. Do you often have headaches?
5. Do you feel pain in your neck and/or shoulders?
6. Do you feel earaches or pain near your ears?
7. Do you notice any noise in your TMJ?
8. Do you regard your bite as normal?
9. Do you use only one side of your mouth to chew?
10. Do you feel any pain in your face when you wake up?

Three response options were offered for the anamnestic questionnaire: “yes”, “no”, or “sometimes”. Value “2” was attributed to every answer indicating the presence of a symptom; value “0”, for the absence thereof; and value “1”, for the “sometimes” answer. The total sum of the values obtained enabled classification of the sample regarding TMD, as a TMD index:

- Values from 0 to 3: free of TMD;
- Values from 4 to 8: mild TMD;
- Values from 9 to 14: moderate TMD;
- Values from 15 to 23: severe TMD.

Assessment of the presence of TMJ painful symptoms was accomplished first by guiding the patients as to the difference between pressure and discomfort in order to ensure more trustworthiness to their responses. This examination was performed through bilateral digital palpation with the examiner’s pointer fingers placed 10-20 mm before the external auditory conduct. The lateral aspect of the TMJ was palpated with patients keeping their mouths closed, whereas the posterior aspect was palpated with patients maintaining their mouths open. These regions were pressed upon gently and continuously with 450-900 kgf⁽¹⁶⁾.

For the examination of muscular palpation, patients were given the same instructions regarding the difference between pain and discomfort. Palpation of the masticatory muscles was performed with digital, bilateral, constant pressure of approximately 1500 kgf⁽¹⁵⁾. Presence of pain was verified through the eyelid reflex and/or by questioning the patient.

Cervical muscles were palpated by clipping one’s fingers as pincers on both sides.

Presence of joint noises, based on right and left TMJ inspection, was also evaluated. This assessment was conducted by placing the pointer fingers lightly upon the region corresponding to the lateral pole of the condyle, before the external acoustic meatus, while the patient performed movements of mandibular opening and closing.

Statistical analysis was performed using the Chi-square and Odds Ratio tests to determine possible correlations between ear pain and TMD. $P < 0.01$ was considered for the univariate analyses, whereas $p < 0.05$ was used for inclusion in the final model for the Chi-square test and the relative risk value, with a 95% confidence interval, in addition to logistic regression analysis for age, gender and tinnitus; the Student’s *t*-test and the Fisher’s exact test were applied for gender.

RESULTS

Of the 199 participants of this study, 75 (37.69%) were male and 124 (62.31%) were female. Mean age was 68.7 years, with a minimum of 60 and a maximum of 85 years. Among them, 88 (44.2%) had tinnitus, 141 (71%) presented changes in the temporomandibular joint (TMJ), and 73 (36.7%) had both.

Mean age was similar for both males (69.9 years) and females (68 years). No difference was observed between genders for the variable age, which evidences a fairly homogeneous sample in this aspect. However, significant difference was found between the variables gender and temporomandibular disorder (TMD) ($p = 0.038$) (Table 1).

Regarding the presence of tinnitus reported by the individuals interviewed, no significant response was observed for gender ($p = 0.976$). No correlation between genders was found for tinnitus in the left and right ears (Table 2).

Regarding prevalence and severity of TMD in relation to gender, presence of TMD was higher in the female gender (77%) compared with that in the male gender. As for the severity of TMD presented, significant difference was observed in females for the moderate (23.4%) and severe (14.5%) levels, whereas no difference was found for the mild level. Assessment results were similar concerning participants free of TMD. Correlation between the results was observed regarding TMD severity and presence of tinnitus, with predominance of the female gender (Table 3).

TMD was observed in 45 (31.9%) males and 96 (68.1%) females, with female participants being 2.20 (95% CI: 1.18-4.11; $p = 0.018$) times more likely to present TMD compared with male participants. Tinnitus was observed in 73 individuals (51.7%) with TMD and showed a relationship between both manifestations. At each occurrence of tinnitus, TMD were 3.71 (95% CI: 1.76-7.82; $p = 0.001$) times more likely occur (Table 4).

Table 1. Sample distribution by age and gender according to the temporomandibular disorder index

Variables	Male (N = 75)	Female (N = 124)	Total (N = 199)	<i>p</i> -value
Age (years)/Mean (± SD)	69.93 (± 6.05)	68.06 (± 5.48)	68.77 (± 5.76)	0.098
TMD Score	0.75 ± 0.73	1.30 ± 0.98*	1.09 ± 0.93	0.038

*Statistically significant difference between genders for $p < 0.05$ (Student’s *t*-test for independent samples); Values shown in mean and standard deviation
Subtitle: TMD = temporomandibular disorder; N = sample size; SD = standard deviation

Table 2. Distribution of elderly individuals according to presence of tinnitus by ear

Variables	Male (n = 75)		Female (n = 124)		Total (n = 199)		p-value
	N	%	N	%	N	%	
Tinnitus	38	50.7	50	40.3	88	44.2	0.976
L Tinnitus	26	34.7	33	26.6	59	29.6	
R Tinnitus	35	46.7	43	34.7	78	39.2	

Subtitle: N = sample size; L = left; R = right; Chi-square test: X^2 ; p = significance level

Table 3. Distribution of elderly individuals according to presence and severity of temporomandibular disorders

TMD severity	Male (N = 75)		Female (N = 124)		p-value
	N	F(%)	N	F(%)	
Free	30	(40)	29	(23.4)*	0.0007
Mild	36	(48)	48	(38.7)	n.s.
Moderate	07	(9.3)	29	(23.4)#	0.0047
Severe	02	(2.7)	18	(14.5)#	0.0032
Total	75	100	124	100	

*Statistically significant difference between genders for $p < 0.05$ (X^2 = Chi-square test); #Statistically significant difference between genders for $p < 0.05$ (Fisher's exact test)

Subtitle: TMD = temporomandibular disorder; N = sample size; F = frequency; n.s. = non-significant

Table 4. Correlation between temporomandibular disorders and independent variables

Variables	With TMD N (%)	Without TMD N (%)	p-value	OR (CI _{95%})
Gender				
Male	45 (31.9)	30 (50.8)	0.018	2.20 (1.18 – 4.11)
Female	96 (68.1)	29 (49.2)		
Tinnitus	73 (51.7)	15 (7.5)	0.001	3.71 (1.76 – 7.82)

Subtitle: TMD = temporomandibular disorder; OR = Odds Ratio with confidence interval (CI) of 95% and p-value

DISCUSSION

In the present survey, severity of temporomandibular disorders (TMD) was significantly higher in females than in males ($p = 0.038$) (Table 1), corroborating the findings of other studies^(15,17,18). Similarly, a research⁽¹⁷⁾ that associated individuals from different age groups (aged 35 to 74 years) with gender, reported sensitivity or pain in at least one muscle in 18.5% of the females and 9.5% of the males regarding the temporomandibular joint (TMJ). In addition, the study found sensitivity or pain at palpation on TMJ in 7.3% of women and 3.4% of men. When addressing the higher incidence in the female gender, some authors⁽¹⁸⁾ reported pain in general, and could not determine a single factor responsible for the higher prevalence of pain in women. Nevertheless, they pointed to some probable causes, such as differences in pain mechanisms and factors not yet identified for the craniofacial system, psychosocial and hormonal differences, and environmental factors⁽¹⁸⁾. In contrast, other authors⁽¹⁹⁾ referred to TMD more specifically, and found no differences between genders. It has also been reported⁽¹⁹⁾ that these differences could exist in populations of Western countries, but not in Asian countries, or that they could be associated with cultural divergences in the perception and communication of symptoms.

Presence of tinnitus was higher in females and in the right ear (Table 2). Regarding gender, some studies reported higher prevalence in males⁽²⁰⁾ whereas other surveys showed the same among females⁽²¹⁾, as in the present research. Higher prevalence of tinnitus in the female population may be due to presence

of hormonal or metabolic changes in this population^(21,22), considering that the changes that occur during the menstrual cycle, gestation, and menopause can lead to impairment of homeostasis of the labyrinthine fluids, which acts directly in the enzymatic processes and neurotransmitters, and may influence the basal metabolism of the inner ear⁽²²⁾.

As for the right ear, such findings may be in line with research on tinnitus theories. Such research has increasingly focused on the exploration of brain-related mechanisms, and generally supposes that tinnitus presents a number of physiological causes^(16,23), such as the cross-talk theory of memory capacity^(23,24), according to which nerve compression can be influenced by auditory structures, as well as by stimulation of non-auditory structures, because the somatosensory system is the only non-auditory sensory system that seems to be associated with tinnitus, as temporomandibular joint syndrome, for instance. In this syndrome, somatic tinnitus can develop from activation of latent, ipsilateral, oto-somatic interaction⁽²⁴⁾. This may explain why, in the present study, difference was observed regarding the side affected by tinnitus, with greater complaint about the right side, because TMJ problems can change this function ipsilaterally, thus it is quite possible for the brain to interpret normal sounds as abnormal, and patients report tinnitus also ipsilaterally.

According to the cross-talk theory, the nerve fibers demyelinated due to lack of electrical insulation may increase the spontaneous activity of different fibers⁽²⁵⁾. This probably results from nerve compression, which can be influenced by auditory structures, as well as by stimulation of non-auditory

structures. Thus, the somatosensory system seems to be associated with tinnitus because of compression changes in the TMJ. Therefore, tinnitus associated with TMD may also be characterized by malfunctioning of the masticatory muscles and TMJ, in addition to pain in the orofacial region, myoclonus of the middle ear muscles, and palatal myoclonus⁽²⁶⁾.

Findings of this study show that there was correlation between tinnitus and presence of TMD in the participants (Table 4). In a population-based investigation, higher prevalence of tinnitus was observed in individuals who exhibited more than two symptoms of TMD, and patients with tinnitus presented greater pain on TMJ palpation and pain on opening the mouth than the individuals in the control group⁽²⁷⁾. The current analysis is in line with the aforementioned investigation, because it evidenced correlation between tinnitus and presence of TMD. Such correlation can be explained by the fact that TMD are part of a group of structural and functional changes in the stomatognathic system that can impair the middle and inner ears, causing otological symptoms such as tinnitus⁽⁶⁻¹⁰⁾. Nevertheless, there is still doubt about the existence of any causal relationship between TMD and otological changes⁽²⁸⁾.

Findings of the present study (Table 4) are also in agreement with those of another research, because investigation of the prevalence of TMD in patients with subjective tinnitus in comparison with those in the control group, and the correlation between TMD, tinnitus, and chronic pain symptoms, showed that of the 199 patients assessed, TMD were more prevalent in those with tinnitus, and concluded that there is correlation between TMD and subjective tinnitus⁽²⁷⁾. Furthermore, a study conducted at the Department of Dental Prosthesis of the Medical Center at Regensburg University, Germany, to examine the prevalence of TMD and tinnitus in a sample of consecutive patients found that prevalence of tinnitus was eight times higher in participants with TMD (36.6%) than in participants without TMD (4.4%)⁽²⁹⁾.

Despite the lack of studies investigating the correlation between TMD and tinnitus in the elderly, one study⁽³⁰⁾ verified prevalence of TMD in the elderly population. The authors highlighted that identification in this population is difficult because the symptoms of these disorders are similar to those commonly found in some systemic disorders associated with aging. Another survey⁽²⁸⁾, which analyzed 11,745 participants in the Korean national health system, observed higher prevalence of tinnitus in individuals with symptoms of TMD (31.2%), whose occurrence of tinnitus was 1.6-fold that of individuals without TMD. The study also observed that women, obese individuals, and individuals aged >65 years, presented higher prevalence of these symptoms. The present research is in agreement with the findings of these studies, considering that correlation between TMD and tinnitus was observed in the elderly.

Based on the present study, it is suggested that research on the improvement of tinnitus based on TMD therapy be conducted with the elderly population considering the particular characteristics of each individual, such as biotype and greater lability to changes in the ear and in the TMJ, metabolic and circulatory changes, eating habits, and lifestyle.

CONCLUSION

Correlation between tinnitus and temporomandibular disorders (TMD) was observed in the elderly population. Thus, new prospective studies should be conducted in order to deepen

knowledge about other manifestations associated with tinnitus and TMD, because this correlation in the population studied demonstrates the importance of identifying risk factors for tinnitus that could be modified by means of specific interventions.

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